Step 5: Adaptive Management

Introduction

Adaptive management is the process by which new information about the health of the watershed is incorporated into the watershed management plan. Adaptive management is a challenging blend of scientific research, monitoring, and practical management that allows for experimentation and provides the opportunity to "learn by doing." It is a necessary and useful tool because of the uncertainty about how ecosystems function and how management affects ecosystems. Adaptive management requires explicit consideration of hypotheses about ecosystem structure and function, defined management goals and actions, and anticipated ecosystem response (Jensen et al. 1996).

The results of this process are essential to validate the Watershed Assessment, to ensure that ecosystem relationships were considered adequately in Synthesis, and to show that management solutions have been implemented and are effective at achieving watershed objectives.

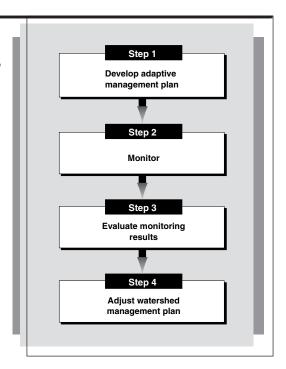
Adaptive Management Process

Step Chart

Procedure

The objectives of the Adaptive Management step are as follows:

- To create a system to monitor changes in the watershed.
- To evalute trends using monitoring data.
- To modify the watershed management plan as necessary.



Step 1. Develop adaptive management plan

The adaptive management plan will define the process for monitoring watershed conditions and, when necessary, modifying the watershed management plan (Box 1). The design of the adaptive management plan is best accomplished in cooperation with policy-level personnel with the authority to make a commitment of resources and technical

Box 1. Key elements of the adaptive management plan

- Monitoring objectives
- · Information needs
- Available financial, technical, and human resources
- Process for evaluating monitoring results and changing watershed management plan
- Data management process
- Process for communicating results of watershed management actions

personnel who can help identify scientific issues and evaluate monitoring data.

The adaptive management group should clearly define the objectives and timelines for watershed monitoring. Using information from the Watershed Assessment and Management Solutions processes, identify gaps in knowledge about watershed conditions and management activities. Prioritize the information needs so that resources can be allocated to the most important issues. Step 2 provides more detail on the type of monitoring to consider and resources for designing and implementing monitoring programs.

Box 2. Adaptive management in Oyster Creek, Texas

The Brazos River Authority in Texas is an example of how a long-term commitment to an adaptable watershed management process can achieve substantial progress. In the Oyster Creek watershed, data collected by volunteers suggested that industrial discharge was impacting water quality. After two years, industry came to better understand how they were affecting water quality. Similarly, the volunteers learned that other non-point source pollution would have to be addressed to solve the problems.

Industry re-engineered their discharge system to remedy the situation when they realized that the data were good and that other causes would be evaluated and addressed. As a result, the partnership has continued to grow, with industry supporting the volunteers with chemical supplies and monitoring kits. In addition, they are funding a constructed wetlands pilot project. A key to the success of this watershed management effort has been keeping the community aware of progress as it is made in the watershed and acknowledging the successes that occur.

Adapted from EPA (1997a)

Watershed management plans that rely on adaptive management require a long-term commitment of resources to ensure success (Box 2). Financial, technical, and other human resources need to be outlined, along with the specific responsibilities of each party.

The adaptive management group should also consider establishing criteria for modifying the watershed management plan based on monitoring results (Box 3). Separate criteria will be needed for each resource of concern, for example, water quality, water quantity, and aquatic life. Consideration should be

Box 3. Examples of criteria to evaluate the effectiveness of a watershed management plan

Watershed Issue	Criteria
Stream Temperature	 All streams shall meet state temperature standards in 10 years: Class A - 16°C Class B - 18°C Class C - 22°C Complete review of stream classes to ensure consistency with beneficial use in 2 years
Fine Sediment	 50% reduction in road sediment delivery to Bear Creek and Crazy Creek sub-basins in 5 years 25% reduction in road sediment delivery to all other sub-basins in 5 years
Fish Passage	 90% of dams and diversions will have fish passage structures in 5 years 80% of irrigation diversions will have fish screens in 2 years, and 100% will in 5 years
Bull Trout	Increase spawning population by 10% after 10 year

given to evaluating implementation and effectiveness at site-specific and watershed scales. Describing the expected detail and quality of monitoring data will allow the community to have confidence in the monitoring results and the need for changes in the watershed management plan.

Data management and the communication of results are also important considerations during the planning process. A great deal of data can be generated from a monitoring program. Managing these data so that they can be effectively analyzed and summarized is critical for maintaining interest and reporting progress on the watershed management plan.

It will be important to highlight trends and effectively communicate successes to the community. Consider how the group wants to promote the watershed management effort. The following strategies can help to educate and promote better watershed management:

- Demonstration sites.
- · Watershed tours.
- Community workshops.
- Information campaigns.
- Brochures.
- Web site.
- Interpretive signs.
- · Student projects.

Step 2. Monitor

Three types of monitoring may be needed to meet management objectives and to evaluate management practices:

- 1. **Implementation monitoring** (also called compliance monitoring) to determine whether standards and guidelines are being properly followed.
- 2. **Effectiveness monitoring** to determine whether the implementation of management solutions is achieving desired objectives.
- 3. **Validation monitoring** to determine whether the predicted results occurred and whether assumptions about the watershed and management system were correct (includes trend and baseline monitoring).

Further detail on designing and implementing monitoring programs can be found in the following documents:

• General

- Inventory and Monitoring Coordination: Guidelines for the Use of Aerial Photography in Monitoring (Bureau of Land Management [BLM] 1991).
- Statistical Methods for Environmental Pollution Monitoring (Gilbert 1987).

Forestry

- Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska (MacDonald et al. 1991).
- Evaluating the Effectiveness of Forestry Best Management Practices in Meeting Water
 Quality Goals or Standards (EPA 1994).
- Techniques for Tracking, Evaluating and Reporting the Implementation of Nonpoint Source Control Measures: II. Forestry (EPA 1997c).

• Agriculture

- Techniques for Tracking, Evaluating and Reporting the Implementation of Nonpoint Source Control Measures: I. Agriculture (EPA 1997b).
- Monitoring and Evaluation of Agriculture and Rural Development Projects (Casley and Lury 1982).

Urban

- Techniques for Tracking, Evaluating and Reporting the Implementation of Nonpoint Source Control Measures: III. Urban Sources (EPA 1997d)
- Environmental Indicators to Assess Stormwater Control Programs and Practices (Clayton and Brown 1996).

Step 3. Evaluate monitoring results

It is beyond the scope of this guide to provide detailed information on statistical analyses, but other issues such as criteria for establishing trends and making changes in management should be established prior to the evaluation of results (Box 3). These standards and criteria may need to be modified based on resulting data.

Step 4. Adjust watershed management plan

A process for incorporating new information into the watershed management plan should be outlined in the adaptive management plan. Specific time frames for reevaluation and adjustment in the watershed management plan should be established. Reevaluation of the management plan will likely occur at 2-, 5-, or 10-year intervals to allow for implementation and monitoring of projects and programs. Standards for applying new information may need to be discussed by policy representatives.

References

- Bureau of Land Management (BLM). 1991. Inventory and monitoring coordination: guidelines for the use of aerial photography in monitoring. BLM, Technical Report TR 1734-1, Washington, D.C.
- Casley, D. J., and D. A. Lury. 1982. Monitoring and evaluation of agriculture and rural development projects. The Johns Hopkins University Press, Baltimore, Maryland.
- Clayton and Brown. 1996. Environmental indicators to assess stormwater control programs and practices. Center for Watershed Protection, Silver Springs, Maryland.
- Gilbert, R. O. 1987. Statistical methods for environmental pollution monitoring. Van Nostrand Reinhold, New York, New York.
- Jensen, M. E., P. Bourgeron, R. Everett, and I. Goodman. 1996. Ecosystem management: a landscape ecology perspective. Water Resources Bulletin 32(2):203-216.
- MacDonald, L. H., A. W. Smart, and R. C. Wissmar. 1991. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska. U.S. Environmental Protection Agency, EPA/910/9-9-001, Washington, D.C.
- U.S. Environmental Protection Agency (EPA). 1994. Evaluating the effectiveness of forestry best management practices in meeting water quality goals or standards. U.S. EPA 841-B-94-005, Washington, D.C.
- U.S. Environmental Protection Agency (EPA). 1997a. Top 10 watershed lessons learned. EPA 840-F-97-001, Office of Water, Washington, D.C.
- U.S. Environmental Protection Agency (EPA). 1997b. Techniques for tracking, evaluating and reporting the implementation of nonpoint source control measures: I. Agriculture. EPA 841-B-97-010, Washington, D.C.

- U.S. Environmental Protection Agency (EPA). 1997c. Techniques for tracking, evaluating and reporting the implementation of nonpoint source control measures: II. Forestry. EPA 841-B-97-009, Washington, D.C.
- U.S. Environmental Protection Agency (EPA). 1997d. Techniques for tracking, evaluating and reporting the implementation of nonpoint source control measures: III. Urban Sources. EPA 841-B-97-011, Washington, D.C.

раде **92**